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National Oceanic and Atmospheric Administration
NATIONAL ENVIRONMENTAL SATELLITE SERVICE
Washington, D.C. 20233

December 18, 1973

Prof. Pierre Morel
Laboratoire de Meteorologie Dynamique
Centre National de la Recherche Scientifique
24, Rue Lhomond
Paris 5e, France

Dear Pierre:

Thanks for the copy of your letter of November 28 to Members of Panel A of COSPAR Working Group VI regarding the possibility of developing a common standard for geostationary meteorological satellite image archiving. I am sending copies of your material to some additional people in NESS concerned with data processing and processing equipment with the suggestion that they write you directly offering any comments and suggestions they may have. This is being done in the spirit of free scientific and technical exchange which is customary in COSPAR. At a later time, of course, it will be necessary to exercise the practical limitations of management, policy and funds in reaching a decision regarding what we would actually do in the United States.

I think it would be useful to provide information to the WMO Executive Committee Panel on Meteorological Satellites as you indicate, and also to the CGMS. As you may know, it is most likely that the first WMO Panel meeting and CGMS IV will be held simultaneously in Geneva beginning May 13.

As a matter of principle, one must agree with the desirability of achieving a common standard for the storage and retrieval of images from all of the geostationary satellites. On the other hand, in the process, one should not block developments which in a few years may permit archiving one kilometer resolution, full disk images which we hope to obtain from GOES. The development of mass memory storage devices is evolving very rapidly now. It would be a shame if early standardization were to seriously limit a much more satisfactory solution to the archival problem a few years hence.

In trying to set standards in 1974 for a system to be implemented about 1977, people may be tempted to predict the date of availability of mass storage and retrieval devices for routine operational use. If they are not reliably and widely available, there will be serious difficulties. All of this leads me to a thought which might be worth considering,

namely a two-level archive. The first level would be internal to each satellite's associated data processing system and be tailored to its unique needs and characteristics. This likely would evolve and improve as technology permits. For example, we soon will be experimenting with a laser read/write device which could provide a very compact and permanent record of extremely high volumes of data. However, such equipment is just becoming available. Therefore, one could not expect very many organizations to have access to this type of equipment for several years to come. Thus, there is a need for a level two in the archiving scheme. Here, the satellite operators might be able to agree to use a format, probably magnetic tape as you suggest, which is computer compatible, and which could be read by a large majority of tape machines in general use.

Each satellite operator would assume the responsibility for providing data transformation between level one and level two, with the cost of producing the transformation and writing the tape being paid by the user(s). Where high resolution images (such as we hope to achieve with GOES) exist, not all images would be converted from the level one master to the level two working format; it would be done on a request basis.

Vern Suomi's group is working on the development of a tape recorder to write high resolution, full disk GOES images in compact form on tape. If successful, reasonably priced and reliable, this might solve the problem.

Best regards and wishes for a Happy New Year.

Sincerely,

David S. Johnson
Director

cc: C. Bristor
J. Leese
F. Kahwajy
L. Hubert
V. Oliver
W.L. Smith
D. Wark
V. Suomi

A PROPOSAL FOR A COMMON STANDARD FOR THE TRANSCRIPTION OF LARGE SATELLITE DATA STORES

Paris, 28 November 1973

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1 - GENERAL PURPOSE OF THE PROPOSAL

It has become clear in the preparation of the Data Management Plan for the First GARP Global Experiment (FGGE) that it is not practical to exchange in real time a large fraction of the raw (unprocessed) satellite observations likely to become available in the normal operation of the Global Observing System. Yet, such raw data are an indispensable information source for later scientific investigation. It has therefore been recommended that the organizations operating meteorological satellite systems accept the responsability of establishing Level I Archives (1) for storing the totality or a fraction of the raw, unprocessed satellite data, as appropriate. A large proportion of this archived information will be stored in digital form and will thus constitute very large digital files.

The problem now is to gain access to this information in a practical way, i.e. by mean of a convenient high density intermediate storage medium which could be easily sent through the mail and would allow fast reading and writing. The magnitude of the problem can be understood by considering for example, the high resolution image data produced by geostationary meteorological satellites.

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(1) : "The First GARP Global Experiment : Objectives and Plans". GARP Publications Series n°11, W.M.O. (1973).

One single satellite system like the European METEOSAT geostationary meteorological satellite should produce one full (IR + visible) image every 30 minutes and each image would just about fill two (2) spools of standard 800 b.p.i. computer compatible magnetic tapes. We are thus discussing a situation where the simple project of examining one single day of data, from a single satellite, would require reading through one hundred standard magnetic tapes. This indeed constitutes a very serious limitation to the effective access to level I archived data.

The purpose of the present proposal is then to examine the possibility of selecting one intermediate storage medium with a large enough data packing density and fast read/write access, which could be commonly accepted by all parties concerned as the standard medium for exchanging large amount (of the order of 10^{10} bits of information or more) of unprocessed satellite data, especially image data produced by scanning radiometers.

What is it for GOES ?

2 - THE RECORDING EQUIPMENT

The most convenient and by far, the most widely available recording medium for intermediate storage of large data files, is the 1/2-inch computer compatible magnetic tape, utilized with either one of 7-track or 9-track parallel recording schemes. However, because of fairly basic limitations of the mechanical design of magnetic tape drives, it is not likely that very high data packing densities will become practical (and widely used) with such parallel byte-recording devices. For this reason it is not proposed that large satellite data files be transcribed on computer compatible magnetic tapes.

On the other hand, any new recording scheme for transcribing such data, is not attractive unless it can fulfill three basic requirements :

- reliability of a proven, widely used recording technique,
- adequate (but not necessarily extreme) recording density,
- moderate cost, commensurate with the ressources of scientific users.

One obvious solution consists in using sequential recording on standard high-density magnetic tapes as used for writing PCM telemetry signals on multi-head instrumentation recorders. A wide variety of such recorders are

available, featuring various arrangements of independent tracks :

(i) 28 tracks on 1-inch tape

(ii) 14 tracks on 1-inch tape

(iii) 7 tracks on 1/2-inch tape

and also various longitudinal recording densities up to 40.000 b.p.i.

Choice (i) would allow twice the data packing densit of either (ii) or (iii) but it must nevertheless be rejec on account of the prohibitive basic equipment cost : one 28-head recorder with 28 independent amplifiers. Now (ii) and (iii) are equivalent in respect of data density but solution (iii) is clearly preferable on account of lower basic equipment cost and better usage of tapes (too many rewindings wear the tape and writing heads out).

It is thus proposed that, for the purpose of exchang large amounts of unprocess ed satellite data, these data b transcribed sequentially o 1/2-inch high density magneti tape using a standard 7-t. ack instrumentation recorder.

3 - RECORDING DENSITY

Three telemetry codes a: e commonly used for sequenti recording of digital data. T iese are :

(i) NRZ-M (non return to zero) code,

(ii) Bi-phase code,

(iii) Miller code.

The Miller code (iii) has robably the best all arou efficiency and is used in most odern recording equipment It is not yet an approved proced re in IRIG standards and was not selected for this reason The bi-phase code is m reliable but allows only half th record density of NRZ.

Thus, the recommended transc iption code for writing 7-track magnetic tape, is the (IR G standard) NRZ-M tele- metry code with a typical record d nsity of 33.000 bits per inch per track.

With such record density, about 90 to 100 full frame METEOSAT imagescould be recorded on a single standard 9200 feet 1/2-inch tape.

4 - FORMATTING

For the purpose of minimizing computer memory requirements for further data handling by scientific users, it is proposed that image data be recorded as a raster of successive scan lines, i.e. in the same format they are acquired. When multispectral information from several radiometer channels are available for each instantaneous field of view or picture element, it can be convenient to record sequentially the data of one channel in one full line, and then the data of another channel and so on. This or alternate arrangements are agreeable as long as further data handling would not require access to more than one full scan line at a time.

Further, it is proposed for the sake of uniformity and ready access to octet oriented computers, that each single measurement be recorded as one (or possibly more than one) 8-bit word plus one parity bit. This will involve expanding artificially the original telemetry format for visible brightness values to 8 bits and thus decrease the effective information density on transcription. This would, on the other hand, greatly simplify the acquisition and further handling of such data (particularly significant for mini-computers).

Finally, the 9-bit words should be arranged in frames of no more than 2048 bits, in conformity with the IRIG standard for pulse code modulation (IRIG Standards for telemetry, Revised February 1969, Document 109-69, Section 5.5).

Pierre MOREL

Chairman of Panel A,
COSPAR Working Group VI:
Application of Space Research
to Meteorology and Earth Surveys

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See p. 2 of Attn: What is No. bits for GOES image?
Use few mass stores & then xfr capability to more common intermediate form for selected items.

Dear Colleague,

The development of a new generation of very powerful meteorological satellites makes available a truly immense wealth of quantitative observations of the Earth Atmosphere. In many cases, these data will indeed be stored in permanent or semi-permanent archives where they could, in principle, be retrieved. The cost of retrieval and particularly the cost of transcribing these data onto a suitable intermediate storage medium may however severely restrict the practical access to these data banks.

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For this reason, I believe it is useful and timely to determine a suitable high-density transcription scheme which could be generally agreeable.

The enclosed proposal for a common standard for the transcription of large satellite data stores has evolved from an original proposal of Laboratoire de Météorologie Dynamique to the European Space Research Organization for the transcriptio of the METEOSAT geostationary satellite archive. It is still of course a tentative definition of a generally agreeable recording scheme. I would therefore very much welcome your comments on this proposal either for suggesting another solution or indicating your tentative agreement with the approach outlined here.

.../...

I intend also to submit this proposal, together with your comments, to the W.M.O. Executive Committe Panel on Meteorological Satellites, to be considered under the general item of the coordination of satellite data management schemes.

I thank you for your attention to this matter and I am waiting for comments, at your earliest convenience.

Very sincerely yours,

Pierre MOREL

Chairman of PANEL A

COSPAR W.G. VI

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